National
Foreign
Assessment
Center

USSR:
Natural Gas Pipelines

A Reference Aid

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National Security Information

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The authors of this paper are
Office of Economic Research. It was coordinated with the Offices of Imagery Analysis and Political Analysis. Comments and queries are welcome and should be directed to

Preface

This paper is the first update of a report on the Soviet gas pipeline network originally published in 1963 [redacted]. It is a reference aid and, as such, includes only a short section describing Soviet pipeline developments and problems. For a thorough discussion of the Soviet gas industry and its problems and prospects see CIA/RR ER 78-10393, *USSR: Development of the Gas Industry*, July 1978. [redacted]

The attached map—which is the focus of this report—depicts *all* known Soviet gas pipelines in operation or under construction. The accompanying tabulation of the major gas pipeline systems in the USSR (see table 1) is limited to those systems that include (a) lines with at least a 40-inch diameter, and (b) lines of 20 inches to 40 inches in diameter that are part of a major pipeline system. By 1980 more than 40 percent of the entire Soviet pipeline network will be comprised of pipe 40 inches in diameter or larger. (A more detailed tabulation of Soviet gas pipelines is listed in the report referenced above.) [redacted]

Appendix A describes pipeline capacity; appendix B discusses the methodology and sources used in preparing this report and their limitations. [redacted]

USSR: Natural Gas Pipelines

The Soviet gas pipeline network has grown very rapidly, increasing from only 5,000 kilometers (km) in 1955 to nearly 120,000 km by the end of 1978. Only about one-fourth the size of the US system, the Soviet network, nevertheless, represents a major construction achievement. A large share of the network was built under conditions comparable to those faced in laying pipelines in Alaska or the Arabian Peninsula. These were characterized by harsh physical and environmental conditions—as in the deserts of Central Asia and the subarctic regions of West Siberia (see figure 1)—and a poorly articulated or nonexistent transportation and support base. Moreover, in the face of a Western embargo on large diameter pipe in the early 1960s, the Soviets developed a domestic production capability by overcoming formidable technology constraints (see figure 2). Multiple pipelines now crisscross the western half of the USSR, linking the gas-rich regions of West Siberia and Central Asia with major consumers in the European USSR and Eastern and Western Europe (see map).

The Soviets began laying large diameter pipe extensively in the 1970s; the USSR is the first country to use 56-inch pipe on a major scale (see figure 3). Although the Soviet Union is the world's largest producer of large diameter steel pipe, it depends heavily on imports from West Germany, Japan, Italy, and others to supplement domestic production.

Inferior pipe metallurgy and compressor technology have hindered the development of the trunk pipeline network somewhat by holding throughput capacity below optimal levels and pushing up gas transportation costs. For the most part, Soviet-produced large diameter pipe is limited to pressures of 55 atmospheres—probably because of metallurgical deficiencies—whereas pipe imported from the West is designed to work at 75 atmospheres or higher. Operating at 75 rather than 55 atmospheres of pressure provides a 45-percent increase in pipeline throughput capacity.

Apart from the pipe constraint, the USSR is unable to provide adequate compressor capacity for the economical operation of the installed pipelines. Many of the major lines operate at 50 to 70 percent of maximum capacity. Moreover, compressor construction is continuing to lag during the 10th Five Year Plan (1976-80). In the last two years less than 70 percent of the planned new compressor capacity has been installed. The fault lies primarily with the lack of adequate domestic production and installation capacity as well as the shortage in hard currency required to supplement domestic compressor production with imports from the West. The showcase Orenburg line (see figure 4) and the Urengoy-Chelyabinsk line will use imported compressors almost exclusively.

Table 1

USSR: Major Natural Gas Pipelines [1]

Pipeline Route	Length (kilometers)	Diameter [2] (inches)	Number of Lines	Capacity (billion cubic feet per year)	Comments
West Siberian Systems					
Urengoy-Medvezh'ye-Nadym-Punga-Vuktyl-Torzhok-Ivatsevichi-Uzhgorod	5,500	48, 56	2-3	1,980	The "Northern Lights" system supplies Moscow, Leningrad, and Europe with gas from fields in Komi and West Siberia.
Urengoy-Medvezh'ye-Nadym-Punga-Nizhnyaya Tura-Perm-Kazan-Gorkiy-Moscow	2,600	48, 56	2-3	1,410-1,770	The "Urengoy-Center" system delivers northern Tyumen' gas to the Urals and Moscow.
Urengoy-Vyngapur-Chelyabinsk	1,600	56	1	1,170	The "Urengoy-Chelyabinsk" system brings Tyumen gas' to the southern Urals. It will operate considerably below capacity until more compressor stations are built. Plans call for two more lines by 1981 and extensions to Kuybyshev and beyond.
Nizhnevartovsk-Parabel'-Tomsk-Kemerovo-Novokuznetsk	1,100	40-48	1	350	This line transports associated gas from the Samotlor oil region to the Kuzbass. It is operating at greatly reduced capacity because of incomplete construction and numerous pipeline breakdowns.
Vologda-Cherepovets-Leningrad	550	40-56	1	710	A branch of the Northern Lights system still under construction.
Soleninskoye-Messoyakha-Noril'sk	300	28, 40	2	390	Northernmost gas pipeline in the world. This line is subject to frequent breakdowns during the winter months, the most recent being in February 1979. Bursting pipes and valves are commonplace due to the extreme cold, and high winds blow the pipe off its elevated supports.
Central Asian Systems					
Bukhara-Chelyabinsk-Sverdlovsk-Nizhnyaya Tura	2,300	40, 48	2	850	The "Central Asia–Urals" system.
Bukhara-Moscow	2,400	40	2	850	"Central Asia–Center" #1 and #2.
Okarem-Beynev-Ostrogozhsk	2,550	28-48	1	140-480	"Central Asia–Center" #3.
Shatlyk-Khiva-Ostrogozhsk	2,600	56	1	1,060	"Central Asia–Center" #4.
Bukhara-Tashkent-Alma Ata	1,350	20, 32, 40	1-3	50-530	
Urals Systems					
Orenburg-Aleksandrov Gay-Novopskov-Kremenchug-Uzhgorod	2,750	56	1	990	The "Orenburg pipeline" (Soyuz) will begin limited operation in 1979, reaching full capacity by the early 1980s. This pipeline, jointly constructed by CEMA, will bring gas from the Urals to the Czech border for export to Eastern and Western Europe.

Table 1 (Continued)

USSR: Major Natural Gas Pipelines [1]

Pipeline Route	Length (kilometers)	Diameter[2] (inches)	Number of Lines	Capacity (billion cubic feet per year)	Comments
Orenburg-Novopskov	1,200	48-56	1	350-710	This line links up with the North Caucasus-Center system (see below).
Orenburg-Dombarovskiy	400	48	1	530	Links Central Asia–Urals lines with Orenburg lines.
Orenburg-Zainsk	500	40	1	300	
Orenburg-Kuybyshev	400	40	1	300	
Ukraine Systems					
Dashava-Dolina-Uzhgorod	200	32, 56	2	1,240	The "Bratsvo" (brotherhood) line transports Soviet gas to Eastern Europe. A third line is under construction.
Dashava-L'vov-Ivatsevichi-Vilnyus-Riga	1,375	20-32	1	250	
Shebelinka-Dnepropetrovsk-Nikolayev-Izmail-Galati (Romania)	900	28, 40	2	420	Export line to Romania and Bulgaria; it also serves Odessa.
Dashava-Kiev-Bryansk-Moscow	1,300	20-28	1	50-140	
Dolina-Kiev	550	40	2	570	
Shebelinka-Kiev	500	28, 40	3	710	
Valday-Pskov-Riga	600	28, 40	1	140-280	
Central Systems					
Krasnodar and Stavropol-Moscow	1,275	28, 32, 40	4-5	1,770	The "North Caucasus–Center" system.
Saratov-Gorkiy-Cherepovets	1,200	20-32	1	210	
Serpukhov-Leningrad	850	28-40	2	420	Extension of the North Caucasus–Center system.
Leningrad-Vyborg-Imatra (Finland)	180	56	1	710	Export line to Finland.
Transcaucasus Systems					
Ahwaz (Iran)-Astara (USSR)-Kazi Magomed	1,200	40	1	420	The "Iranian Gas Trunkline" (IGAT I) is an import line, which supplies the Transcaucasus region with 353 billion cubic feet a year. A second line (IGAT II), which is under construction, will provide the USSR with an additional 600 billion cubic feet by 1984.[3]
Karadag-Yerevan and Tbilisi	770	28, 40	2	420	A third line is under construction.

[1] Major pipeline systems include (a) lines with at least a 40-inch diameter and (b) lines of 20 inches to 40 inches in diameter that are part of a major pipeline system.
[2] To convert to millimeters, as pipeline diameters are shown on the map, see Table 2, page 7.
[3] Iranian gas deliveries to the USSR via this line were suspended from November 1978 to April 1979.

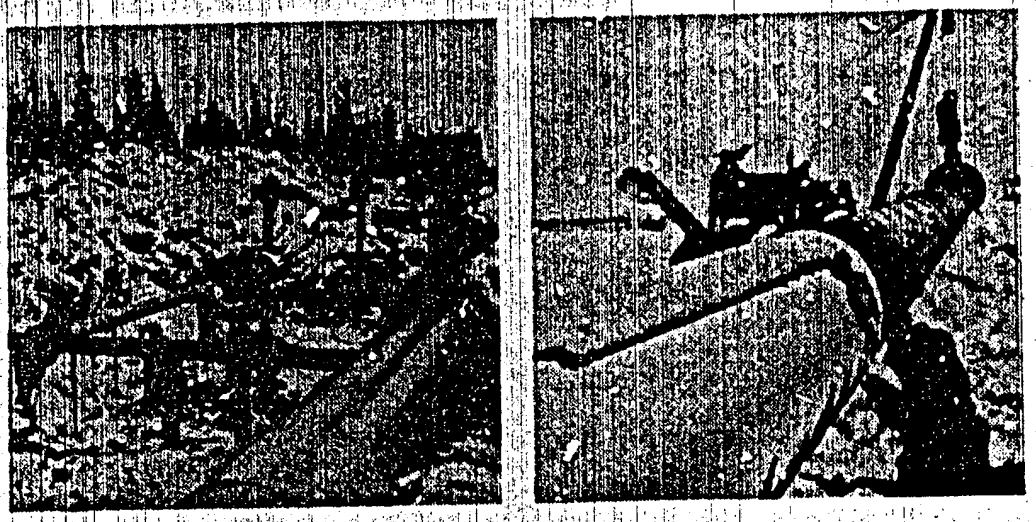
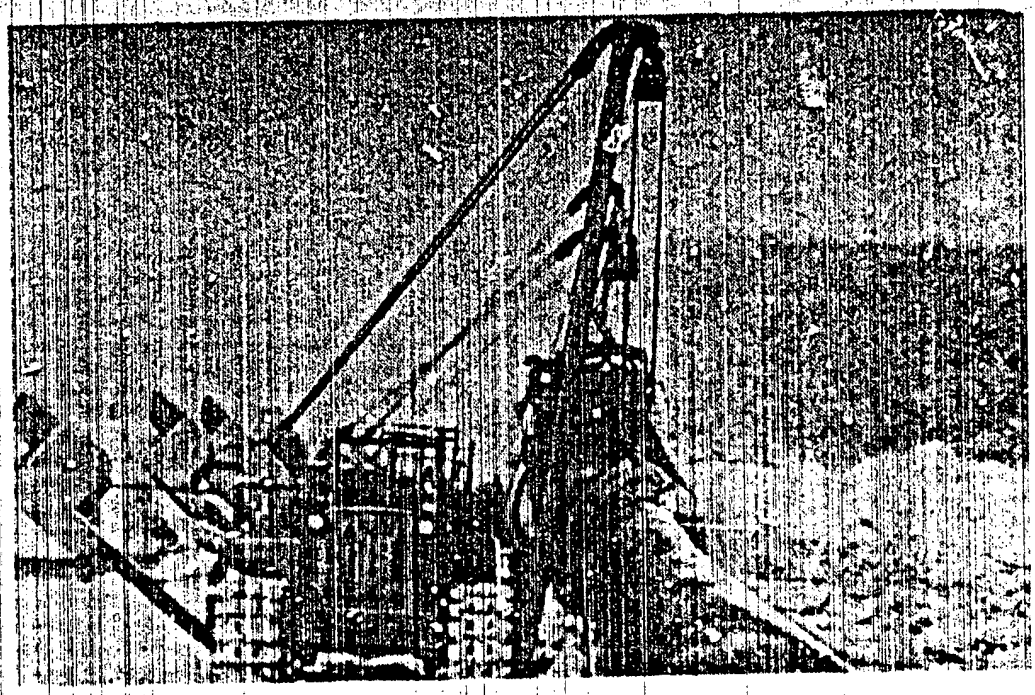


Figure 1. Difficult conditions of Arctic pipeline construction in West Siberia.



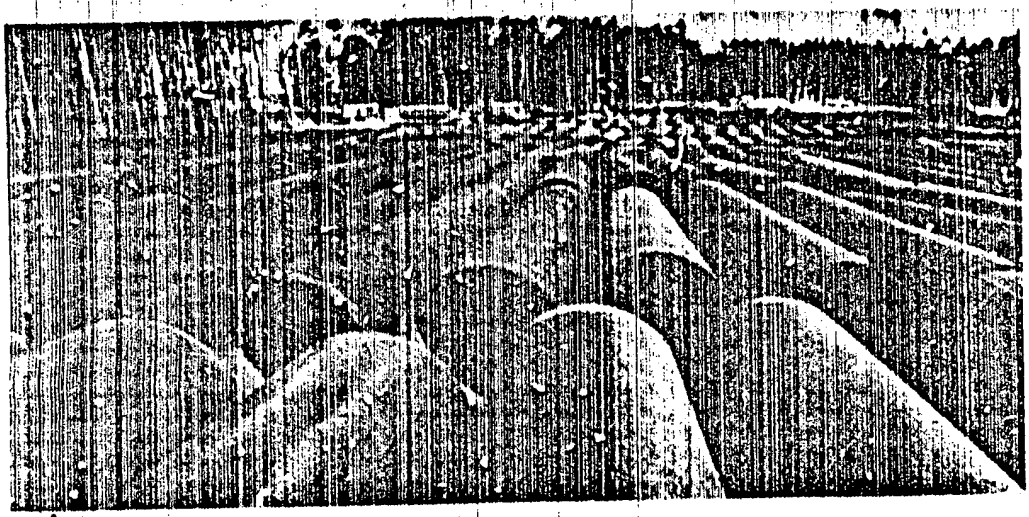


Figure 2. Large diameter pipe for the Urengoy-Chelyabinsk gas pipeline.

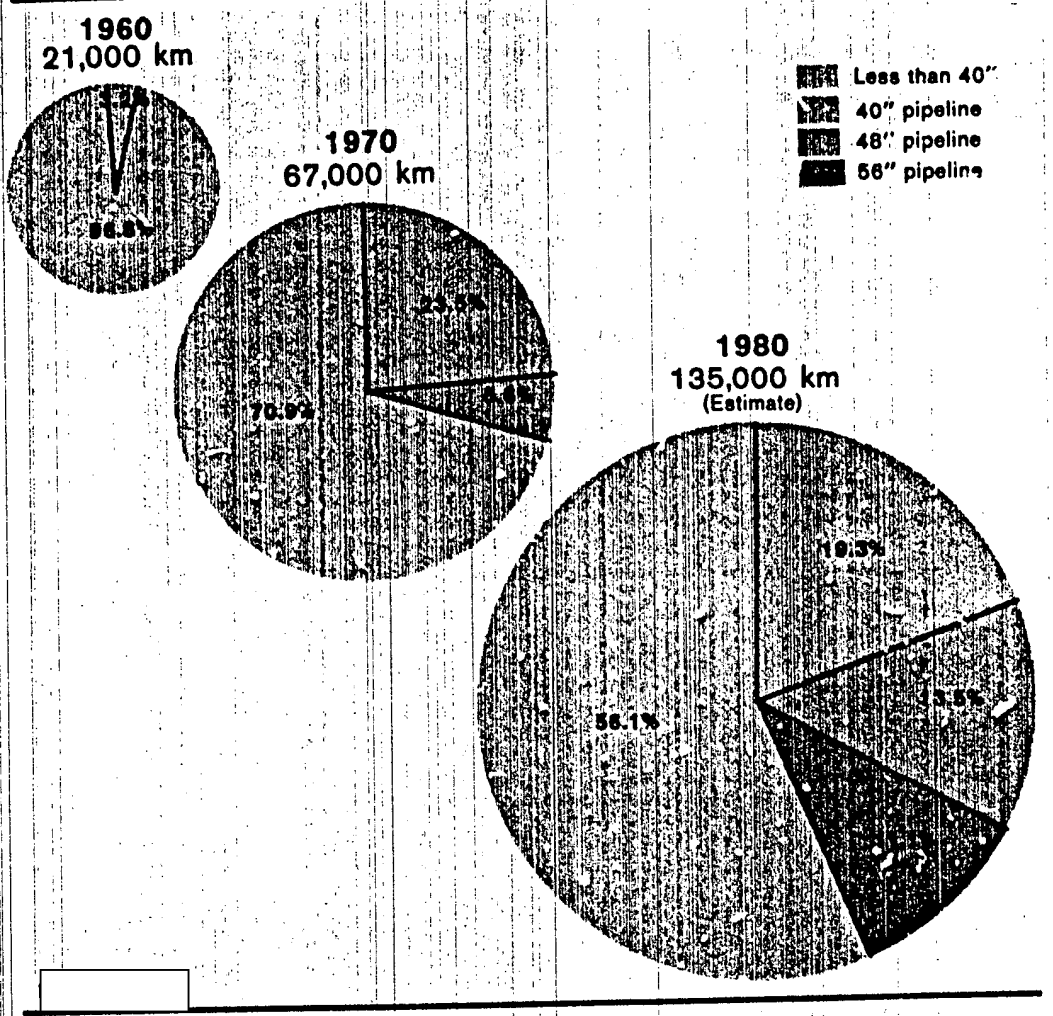


Figure 3. USSR: Distribution of Gas Pipelines, by Size

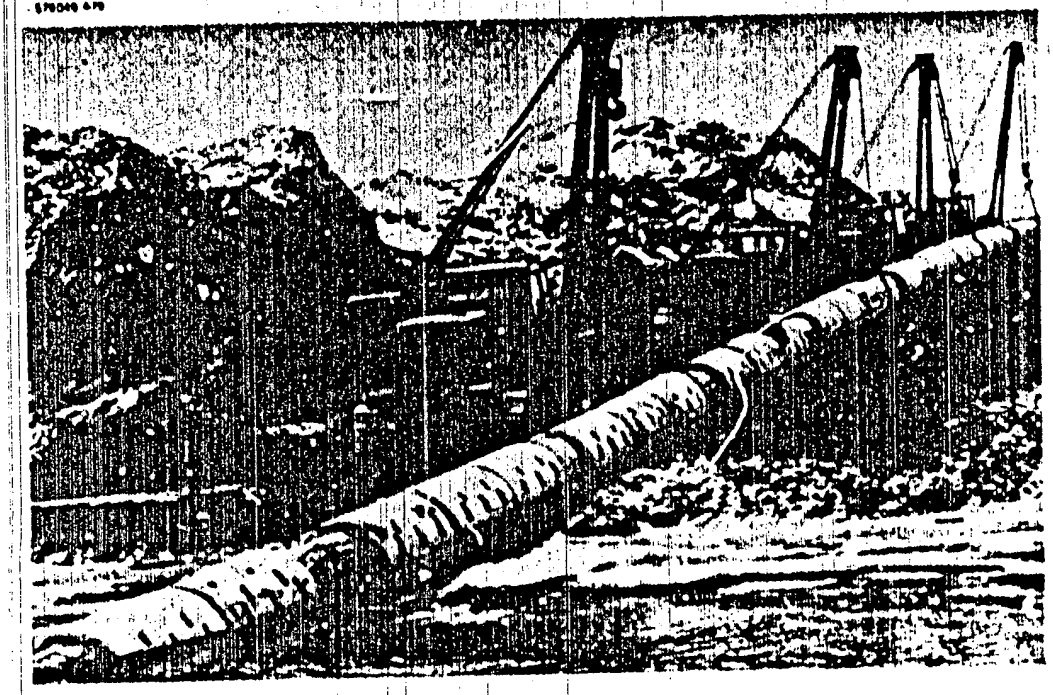


Figure 4. Construction of the Orenburg gas pipeline at a river crossing in the Carpathian mountains.

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Appendix A

Explanatory Notes

The capacity of a gas pipeline system is largely a function of three parameters: pipeline diameter, operating pressure, and the number of strings or lines on a given route. Improvements in gas pipeline technology in the last several decades have included the use of large diamater pipe, higher strength steels (which allow higher operating pressures and thus greater throughput), and large gas turbine compressor units, some of which employ modified aircraft jet engines.

Diameter

Pipeline diameters are shown on the map where known. On multiple lines, the size of the individual lines are shown, separated by commas. Where the data are uncertain or reports provide conflicting information, a probable range of diameters is shown separated by a hyphen. Thus 32", 40" would indicate a twin pipeline in which one line is 32 inches in diameter and the other line is 40 inches in diameter, whereas 32"-40" would indicate only one line, whose diameter is likely to be in the range of 32 to 40 inches, but whose exact size is not known. Pipe that is 32, 40, 48, and 56 inches in diameter corresponds roughly to 820, 1,020, 1,220, and 1,420 millimeter pipe, respectively.

Compressor Stations

Compressor stations are noted on the map when information exists on their precise location. Compressor station information is usually much more complete for the newer or larger lines and for the more publicized lines, such as the Orenburg pipeline.

Throughput Capacity

Throughput capacity is a function of pipe size and operating pressure. Operating pressure is a function of pipe quality and compressor station size and spacing. Rough estimates of maximum throughput capacity for Soviet gas pipelines can be read from table 2 for different combinations of pipe diameters and operating pressures. Capacity values are only approximations and can vary, depending on actual compressor spacing.

System Capacity

System capacity is the sum of the throughput capacities for each line between any two given points. In many cases, because the demand for gas far exceeds the transport capacity of any one line, multiple lines are laid in parallel. Only those lines that are either operational or under construction are shown on the map, and their status of completion is indicated. Planned lines have been excluded because of incomplete information on locations, diameters, and projected completion dates.

Table 2

USSR:
Natural Gas Pipelines

Diameter		Pressure[1] (kg/cm^2)[2]	Throughput Capacity	
Millimeters[1]	Inches		Billion cubic meters/yr[1]	Billion cubic feet/yr[1]
330	(13)	55	0.5	(20)
520	(20)	55	1.5	(50)
720	(28)	55	4.0	(140)
820	(32)	55	6.0	(210)
1,020	(40)	55	8.5	(300)
1,020		75	12.0	(420)
1,020		100	17.0	(600)
1,220	(48)	55	13.5	(480)
1,220		75	19.0	(670)
1,220		100	27.0	(950)
1,420	(56)	55	20.0	(710)
1,420		75	29.0	(1,020)
1,420		100	41.0	(1,450)

[1] *Stroitel'stvo Truboprovodov*, No. 3 (1971), pp. 20-22.
[2] Equal to 14.22 lbs/sq. in.

Appendix B

Methodology and Limitations

The primary material for this project was obtained from collateral sources. The *Review of Sino-Soviet Oil*, Soviet monographs, journals, and newspaper articles, a [redacted] were the most important sources. Additional sources included classified reports and both classified and unclassified maps. These sources were supplemented [redacted], primarily to resolve conflicts and contradictions. [redacted]

The use of Soviet press reports requires some caution. Some reports give indefinite terminal points (for example, West Siberia - Urals) when in fact the information refers to one specific segment (for example, Nadym-Punga) of the overall string. In other cases, a report will state that a pipeline has gone into operation even though, again, it is referring to only one particular section of the line. Moreover, multiple line systems often have more than one string under construction at the same time, making it difficult to determine which string is being discussed. In other cases, lines have been reported under construction for many years, leading to doubts about the status of such a line. [redacted]

The map resources used were a 1975 edition of a gas pipeline map [redacted] a 1977 map published in Moscow, a dated but detailed CIA gas pipeline atlas, Operational Navigation Charts (ONCs) produced by the Defense Mapping Agency, and a large-scale (1:250,000) map series [redacted]

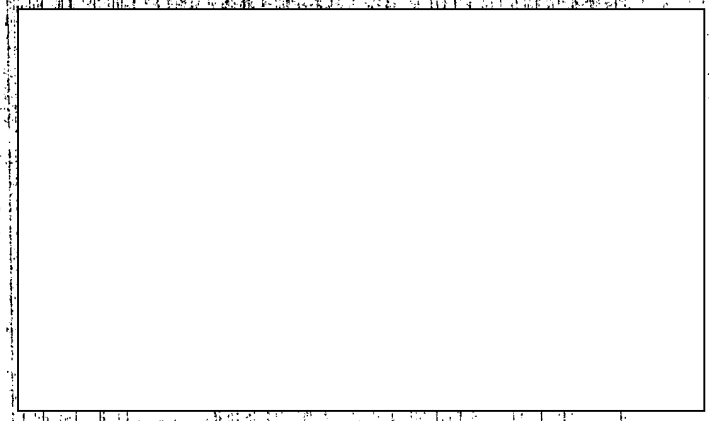
The West German map, though depicting a number of lines that apparently do not exist, was, nevertheless, a valuable source. In addition to portraying individual strings, it provided information on pipeline size and greatly facilitated accurate pipeline mapping by showing a good many intermediate points along each route. [redacted]

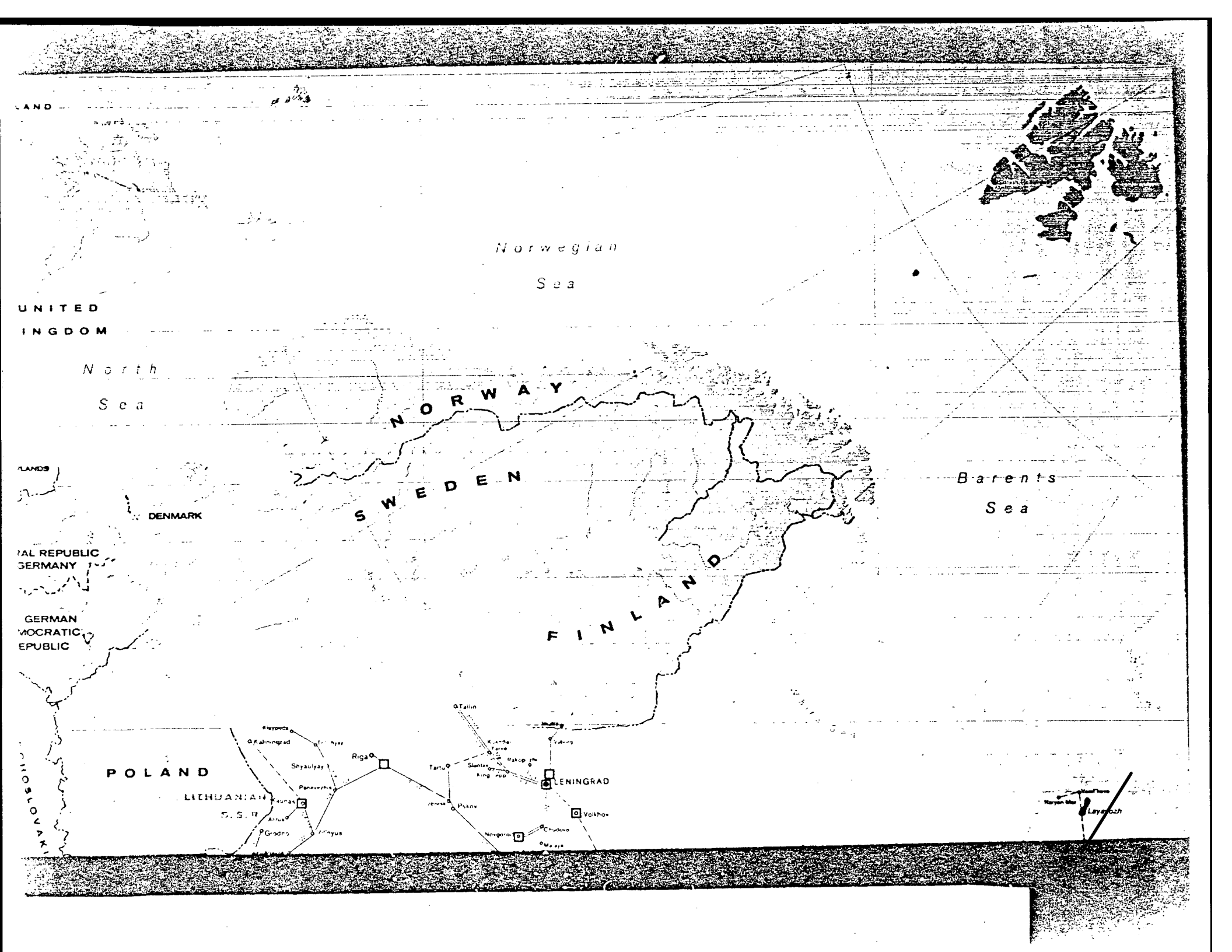
Two Soviet source maps were also useful. The first portrays not only the main pipelines, but also additional economic data. The second, which appeared in the January 1979 issue of the Ministry of Gas monthly, *Gazovaya promyshlennost'*, is the most current depiction of the existing Soviet pipeline network. Although individual strings and some important branch lines are shown, the routes are portrayed in a schematic and imprecise fashion. [redacted]

The CIA gas pipeline atlas was the primary source of information for pipelines in operation prior to 1961. Among the most detailed sources were the ONC charts. They were produced at a scale of 1:1,000,000 and are primarily intended for air navigation. In addition to the aeronautical information, major topographic features are shown. Included are some major gas pipelines with their routes accurately plotted. [redacted]

The [redacted] series at an even larger scale of four miles to the inch was also a valuable source, especially in locating older lines. As with many large-scale mapping projects, many of the individual sheets are out of date, some by more than a decade. Another problem with this series was a lack of continuity. One sheet may show the existence of a pipeline, the next adjoining sheet may not show the line at all, and the following sheet may pick up the pipeline route again, but with discrepancies in pipe sizes and the number of strings. [redacted]

[redacted] was also employed in preparing this research aid. This source was used primarily to (a) resolve some of the contradictions in the collateral source material and (b) to confirm the existence and status of certain important pipelines appearing in collateral sources. [redacted]

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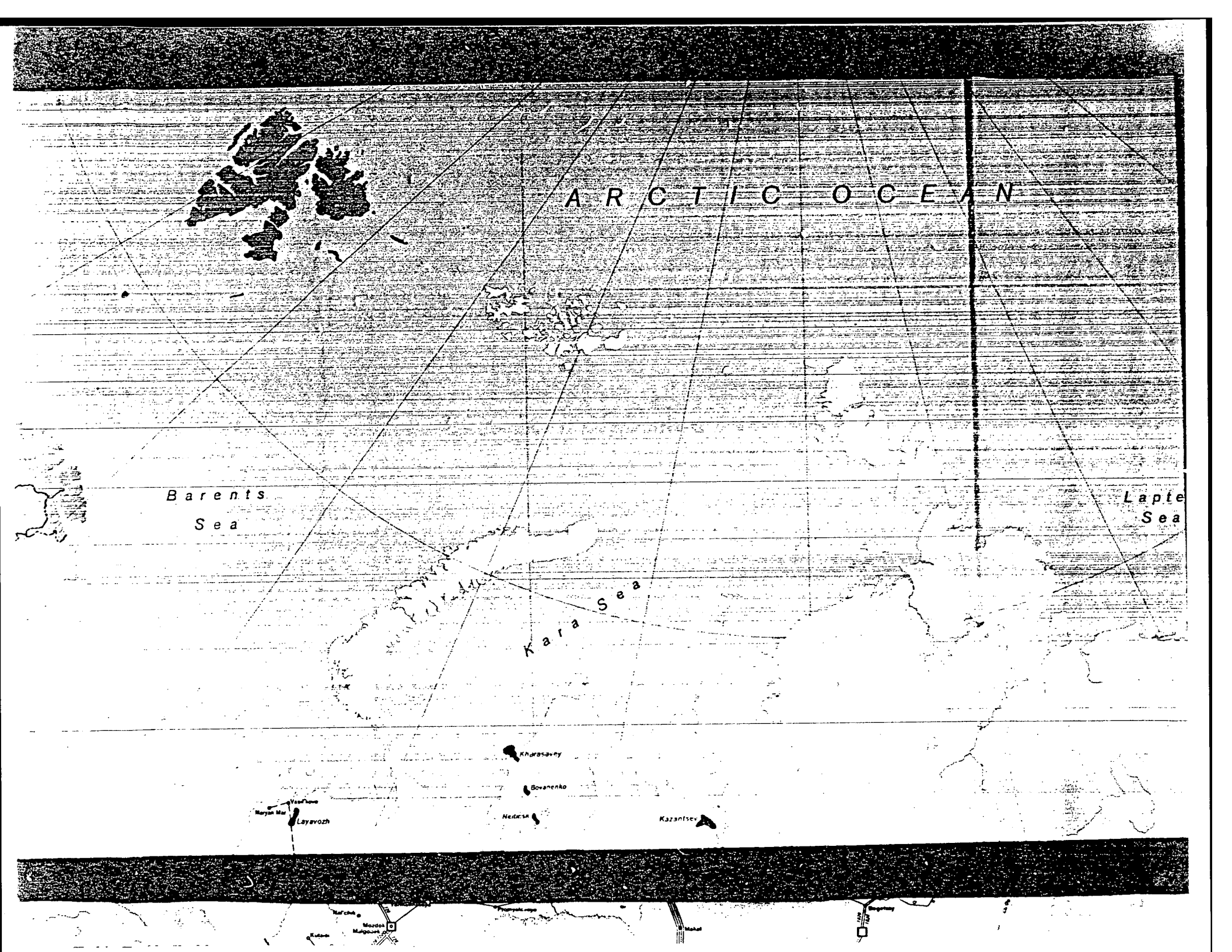
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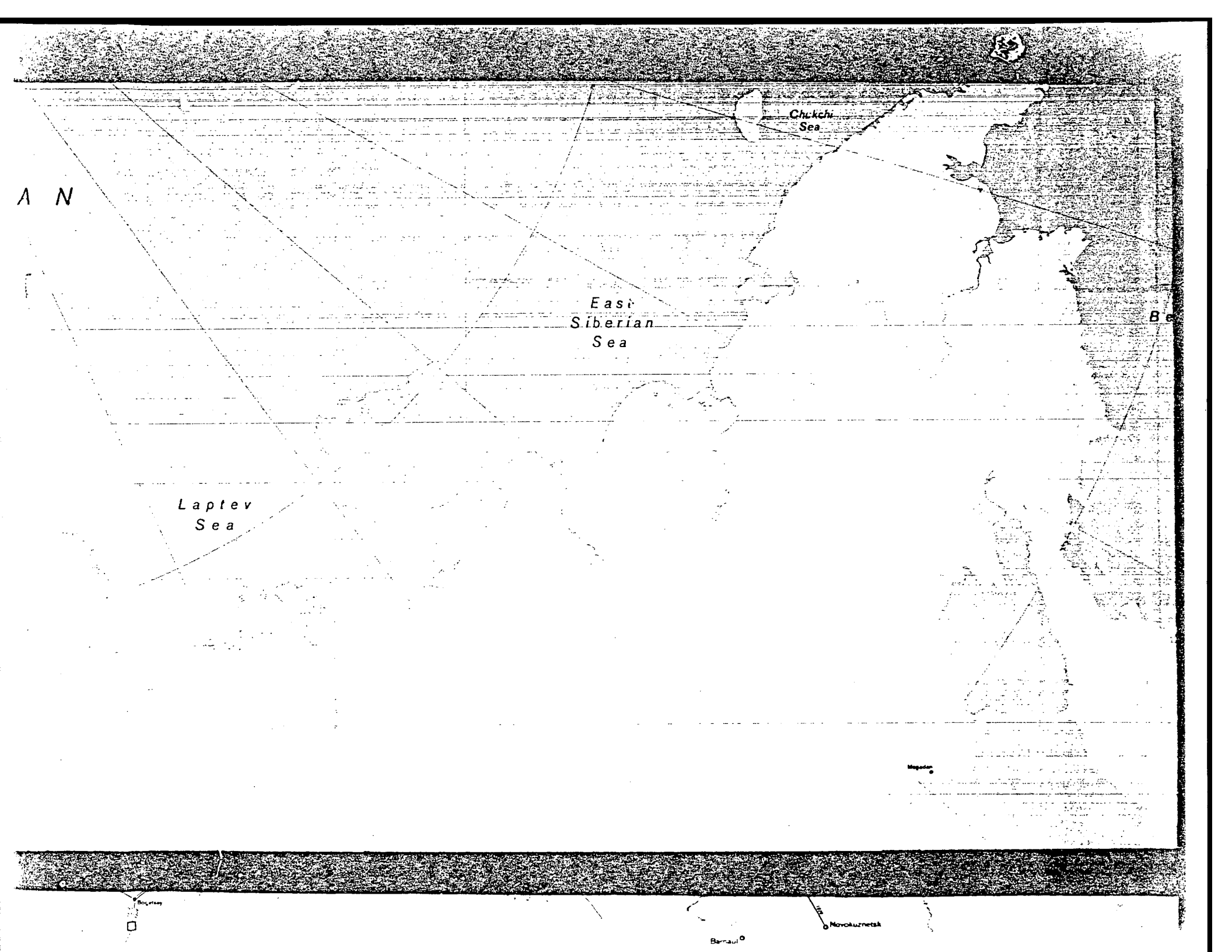
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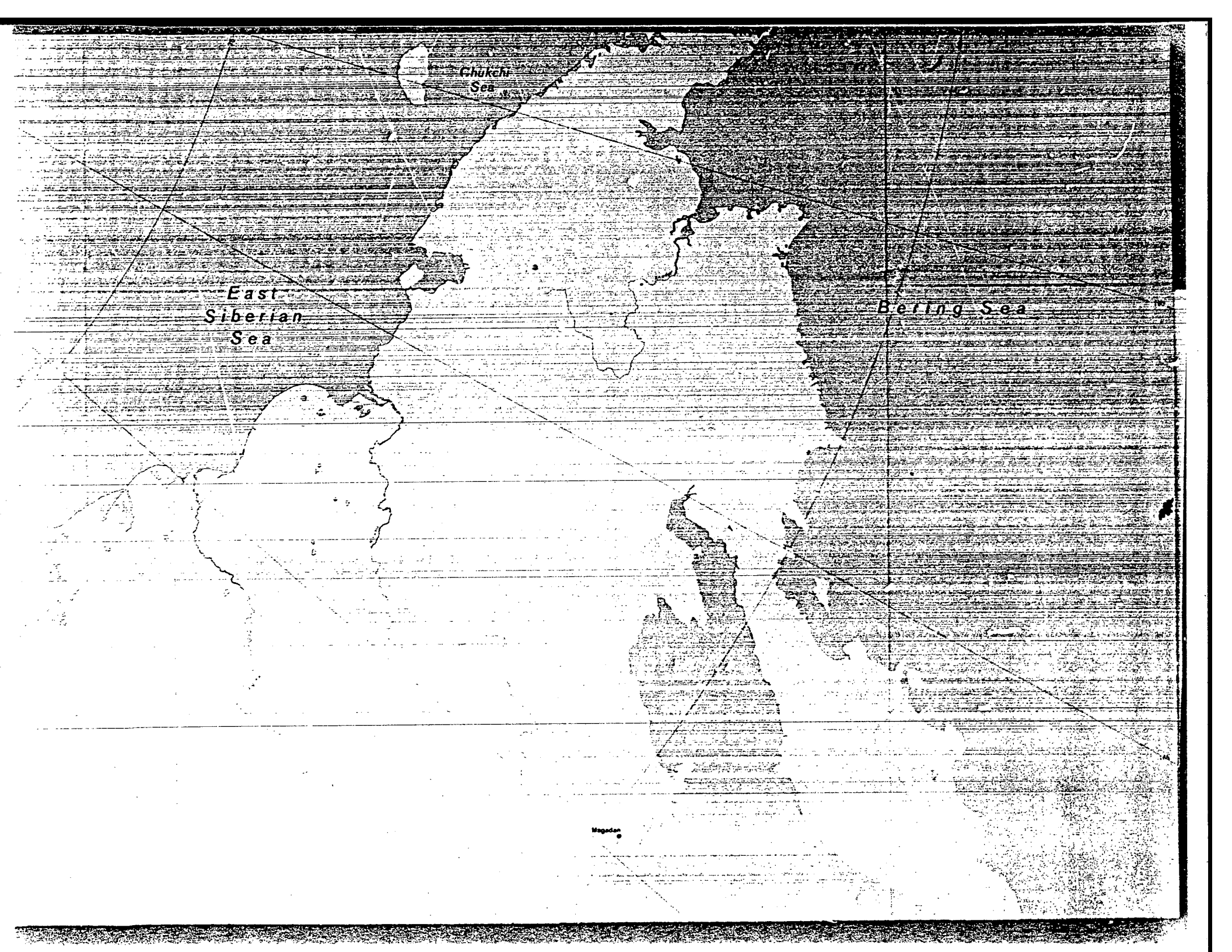
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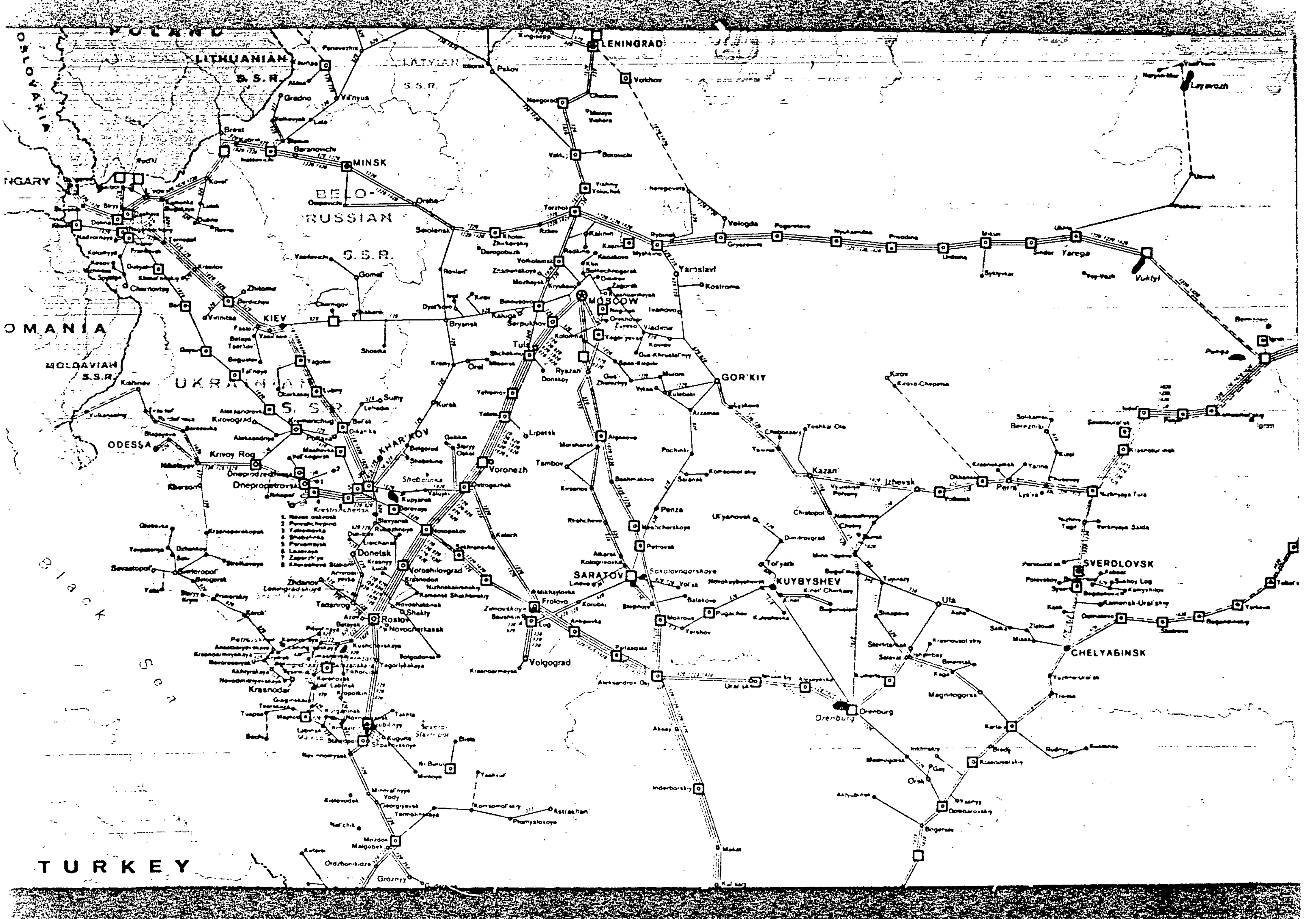
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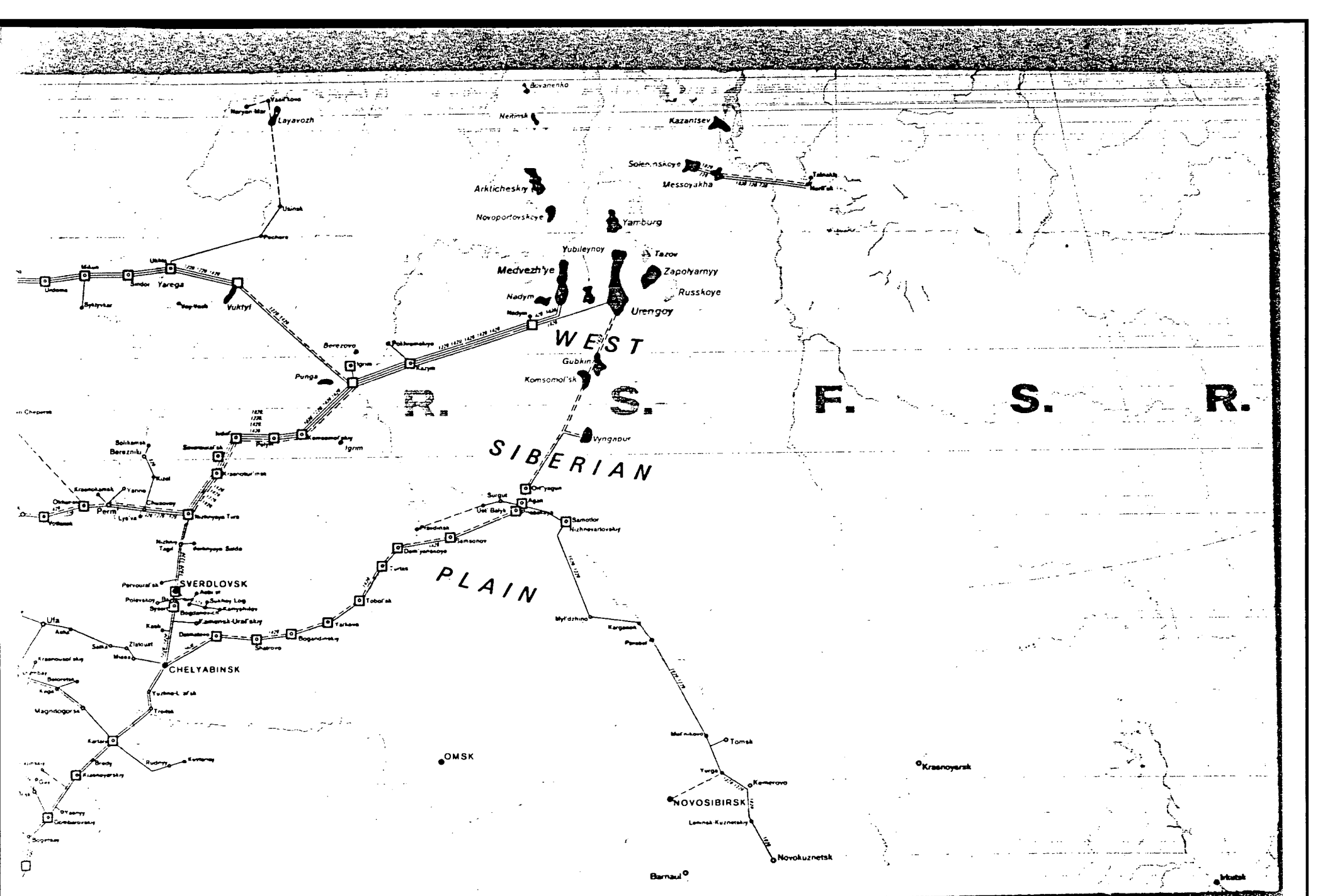
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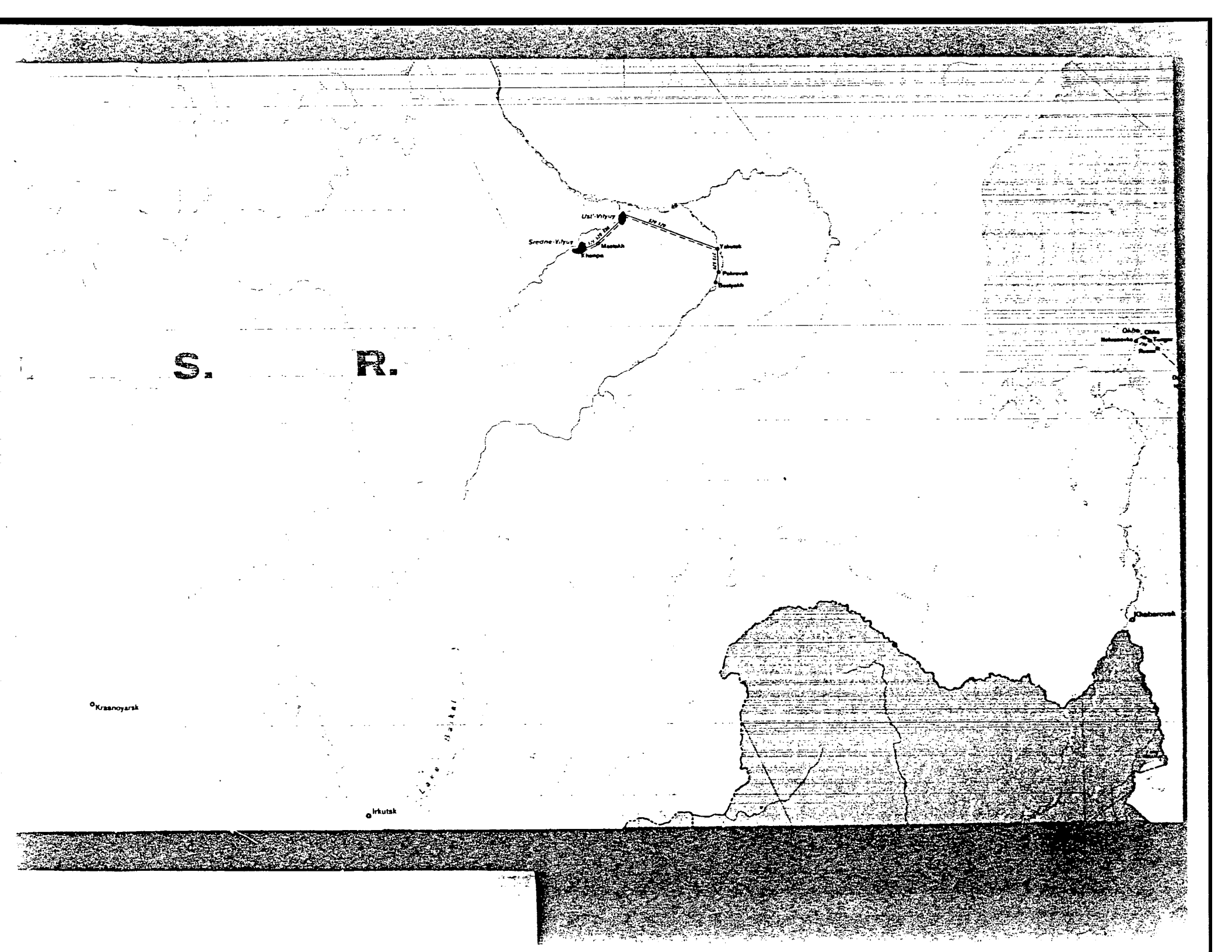
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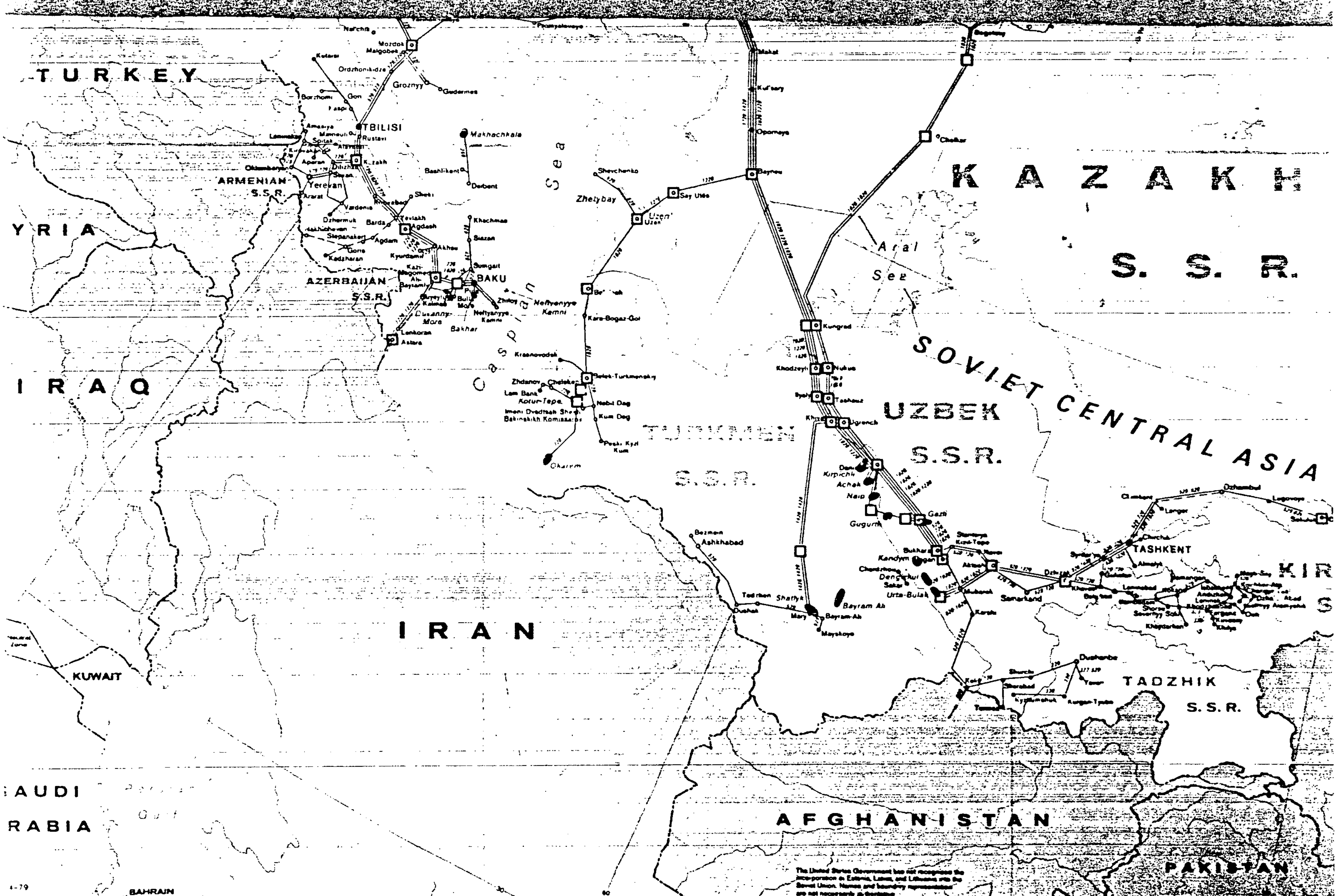
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The United States Government has not recognized the incorporation of Estonia, Latvia, and Lithuania into the Soviet Union. Names and boundary representation are not necessarily authoritative
4-79


U.S.S.R.
Natural
Pipeline (diameter in millimeters)*
Pipeline under construction
Compressor station (known location)
This map depicts only transmission pipeline
show either field gathering lines or distribution
*Diameters for multiple pipelines are not giv
order. When the pipeline diameter is uncertain
is given, and when a diameter is not shown, th
One inch equals 25.4 millimeters.
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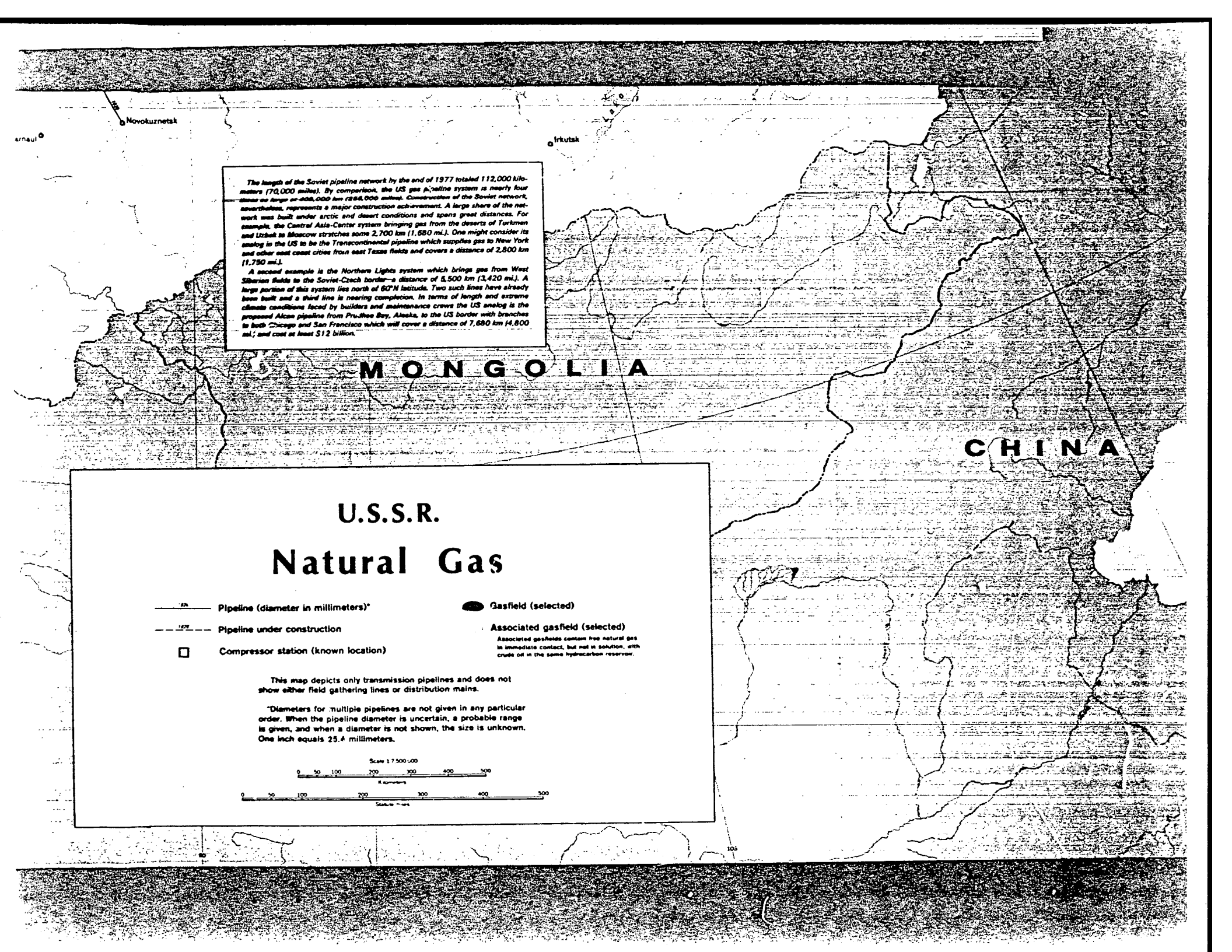
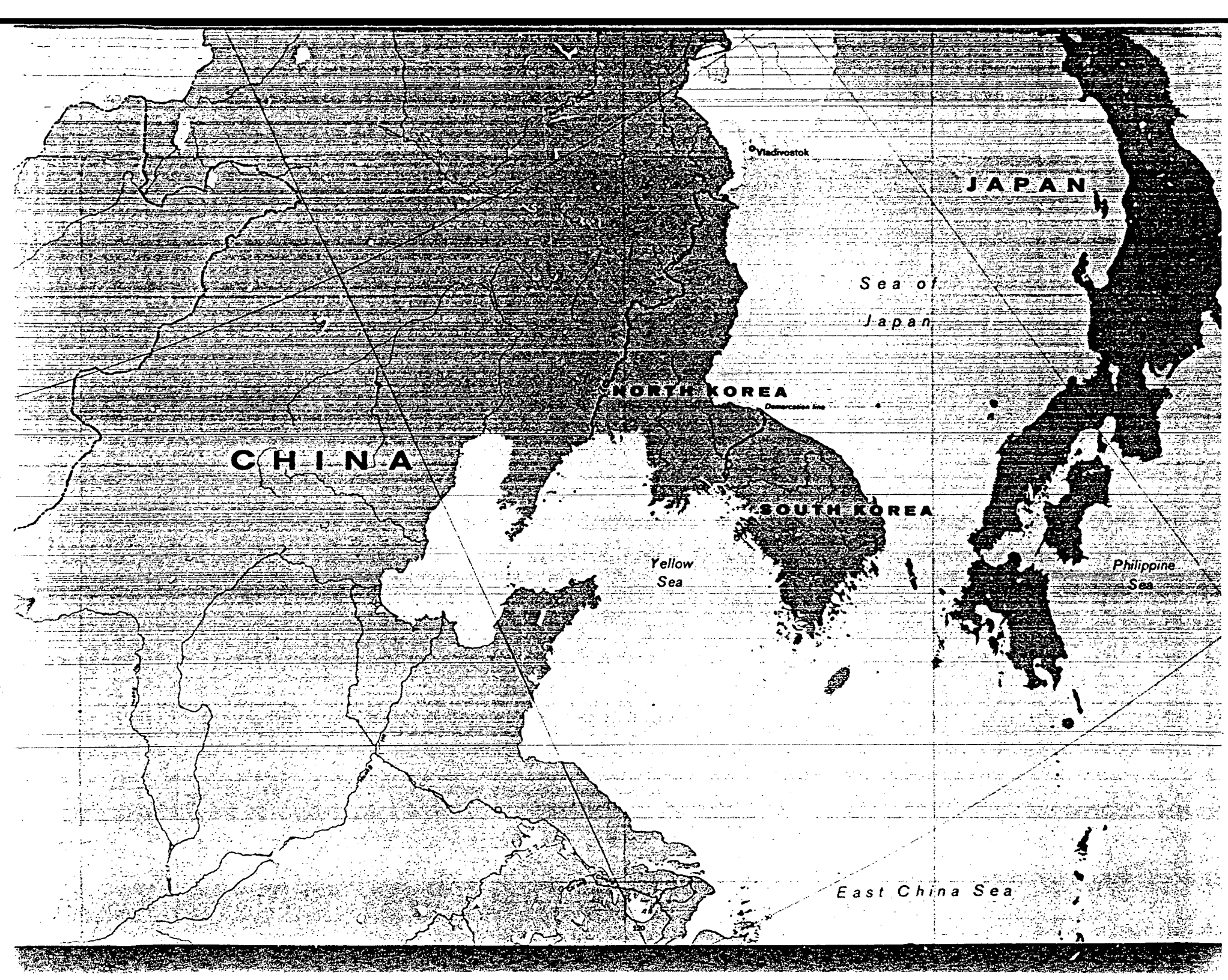


The length of the Soviet pipeline network by the end of 1977 totaled 112,000 kilometers (70,000 miles). By comparison, the US gas pipeline system is nearly four times as large at 408,000 km (256,000 miles). Construction of the Soviet network, nevertheless, represents a major construction achievement. A large share of the network was built under arctic and desert conditions and spans great distances. For example, the Central Asia-Center system bringing gas from the deserts of Turkmen and Uzbek to Moscow stretches some 2,700 km (1,680 mi.). One might consider its analog in the US to be the Transcontinental pipeline which supplies gas to New York and other east coast cities from east Texas fields and covers a distance of 2,800 km (1,750 mi.).

A second example is the Northern Lights system which brings gas from West Siberian fields to the Soviet-Czech border—a distance of 6,500 km (3,420 mi.). A large portion of this system lies north of 60°N latitude. Two such lines have already been built and a third line is nearing completion. In terms of length and extreme climate conditions faced by builders and maintenance crews the US analog is the proposed Alcan pipeline from Prudhoe Bay, Alaska, to the US border with branches to both Chicago and San Francisco which will cover a distance of 7,680 km (4,800 mi.), and cost at least $12 billion.


Vladivostok
JAPAN
Sea of
Japan
NORTH KOREA
Demarcation line
CHINA
SOUTH KOREA
Yellow
Sea
Philippine
Sea
East China Sea